School	
Major	Bachelor of Engineering in Electronics Engineering - Emphasis on Biomedical Engineering

Core Requirements			
Code	**Title**	**Credits**	**Description**
CHEM200	General Chemistry	3	Basic principles of chemistry, electronic structure of the atom, chemical periodicity, molecular structure and bonding, acids and bases and the states of matter, rates of chemical reactions, and chemical equilibrium are covered in this course. Prerequisites: ENGL 150; CHEM, or S grade on the Chemistry Placement Test Prerequisites: CHEM160, ENGL101. Co-requisites: CHEM200L.
MATH210	Calculus II	3	The course material includes hyperbolic functions and their inverses and their derivatives integration techniques, improper integrals, sequences, infinite series, power series, Taylor and Maclaurin series and application of power series. The mathematical software Maple will be introduced and used in support of the comprehension of the material. Prerequisites: MATH160
MATH225	Linear Algebra with Applications	3	Introduction to the systems of linear equations and matrices, Gaussian eliminations, matrix operations, inverses, types of matrices, determinants and their applications, vector spaces, subspaces, linear independence, basis and dimension, rank and nullity, inner product spaces and orthogonal bases, eigenvalues and eigenvectors, applications from other disciplines such as physics, computer science, and economics.
PHYS220	Physics for Engineers	3	Electricity, Electric Field and Electric Potential, Magnetism, Biot-Savarat Law, Ampere□s Law, Faraday□s Law, Fluid Mechanics, Wave Motion, Sound Waves, Superposition and Standing Waves, Temperature, Heat, Laws of Thermodynamics.
MATH220	Calculus III	3	This text covers basic topics on infinite series, lines and planes in space, cylinders and quadric surfaces, functions of several variables, limits and continuity, Partial derivatives, chain rule, directional derivatives, Gradient vector, tangent planes, double and triple integrals, areas, moments, center of mass, volumes, double integrals in polar forms, triple integrals in cylindrical and spherical coordinates, line integrals, vector fields Green□s theorem, surface integrals, Stokes theorem, and the divergence theorem. Students are required to solve extensive number of problems and computer assignment using the mathematical software package Maple.
CSCI250	Introduction to Programming	3	This course introduces the basic concepts and principles of structured programming in Java. It starts by an introduction to Java showing its syntax and the structure of a program in Java then teaches simple data types, control structures, methods, arrays, and strings.
CSCI250L	Introduction to Programming Lab	1	This course is a co-requisite for the Introduction to Programming course (CSCI250). The students apply in the lab the fundamentals of programming, explained in CSCI250, by solving lab exercises. The objective of the lab is to implement programming problems using basic data types, selection and repetition structures, methods and arrays.
EENG250	Electric Circuits I	3	Introduce techniques of DC circuit analysis (Node, Mesh, Superposition, & Source Transformation) containing ideal and dependent sources. Covers real power calculations, perform equivalent resistive circuits. Introduce concept of Thevinin and Norton equivalent circuits, basic concept of mutual inductance, and determine the transient responses of RL, RC, parallel and series RLC. Prerequisites: ENGL051. Co-requisites: MATH210
MATH270	Ordinary Differential Equations	3	First-order equations, linear and non-linear differential, linearization, numerical and qualitative analysis, second-order equations, existence-uniqueness theorem, series solutions, Bessel s and Legendre s functions, Laplace transforms, systems of differential equations, applications and modeling of real phenomena. Prerequisite: MATH 220.

MENG250	Statics	3	This course treats only rigid-body mechanics and forms a suitable basis for the design and analysis of many types of structural, mechanical,__electrical devices encountered in engineering. As the course name suggests, this course deals with the equilibrium of bodies that are either at rest__move with constant velocity. Therefore, this Statics course provides the students with the principles that treats the Statics of particles and rigid bodies, trusses, frames, machines; centroids, centers of gravity; and friction. Prerequisites: ENGL051. Co-requisites: MATH210.
MATH310	Probability & Statistics for Scientists & Engineers	3	The concept of probability and its properties, descriptive statistics, discrete and continuous random variables, expected value, distribution functions, the central limit theorem, random sampling and sampling distributions, Hypothesis testing. Prerequisite: MATH 170
ENGG300	Engineering Economics	3	This course covers the fundamentals of Engineering Economics for engineering professionals to match engineering practice today. It recognizes the role of the engineer as a decision maker who has to make and defend sensible decisions. It emphasizes on the analytical consideration of money and its impact on decision making as well as on other factors such as environmental and social factors and tasks. By the end of the course students will be equipped with basic analytical skills for solving problems of an economic nature real-world example.
ENGG450	Engineering Ethics and Professional Practice	3	Engineering Profession and Ethics is a complete study course on the role of ethics in engineering in their historical, philosophical and professional contexts. The course examines the impact of ethical theories and their application to issues encountered in the engineering profession, such as employee rights, whistleblowing, safety, risk and liability, professional responsibility to consumers and employers, conflicts of interest, codes of ethics, legal obligations, environmental and social responsibility. Through the use of real and hypothetical case studies, the course focuses on developing analysis techniques and applying them to ethical problems through independent critical thinking and moral sensitivity.
ENGG200	Introduction to Engineering	3	Introduction to Engineering is a first-year course designed to help first semester students explore the world of engineering by introducing them to what engineers do, the fundamental principles that form the basis of their work, and how they apply that knowledge within a structured design process. The course is designed to be an ideal introduction for anyone interested in exploring the various fields of engineering and learning how engineers work to solve problems. Students will be helped to decide which major within the school suits them better. The course aims to prepare students for success at LIU and beyond by teaching them important skills including: Technical problem solving and engineering design, teamwork, and communicating to diverse audience.

General Education Requirements			
Code	**Title**	**Credits**	**Description**
ENGL201	Composition and Research Skills	3	This course focuses on the development of writing skills appropriate to specific academic and professional purposes; the analysis and practice of various methods of organization and rhetorical patterns used in formal expository and persuasive writing; the refinement of critical reading strategies and library research techniques; and the completion of an academically acceptable library research paper. Prerequisites: ENGL150, ENGL151.
ENGL251	Communication Skills	3	The objectives of this course are to improve students writing skills for academic purposes by developing effective use of grammatical structures; analytical and critical reading skills; a sensitivity to rhetorical situation, style, and level of diction in academic reading and writing; and competence in using various methods of organization used in formal writing.
ARAB200	Arabic Language and Literature	3	This course is a comprehensive review of Arabic Grammar, Syntax, major literature and poetry styles, formal and business letters.

CULT200	Introduction to Arab - Islamic Civilization	3	The purpose of this course is to acquaint students with the history and achievements of the Islamic civilization. Themes will include patterns of the political and spiritual leadership; cultural, artistic, and intellectual accomplishments Prerequisites: ENGL051, ENGL101, ENGL151.

Major Requirements			
Code	**Title**	**Credits**	**Description**
EENG300	Electric Circuits II	3	Introduce techniques of AC circuit analysis, containing ideal and dependent sources. Covers sinusoidal steady state power calculations, balanced three phase circuits, frequency selective circuits and two-port circuits in addition to Operational amplifiers (Op-amps).
EENG301L	Electric Circuits Lab	1	The Electric Circuits Lab introduces the students to circuit simulation tools, DC circuit analysis techniques such as nodal, mesh, Thevenin, Norton, & superposition, and transient circuit analysis of RC, RL, & RLC circuits.
EENG304	Biology for Biomedical Engineers	3	This course represents an introductory level course to the organization of human life science. It treats the following subjects: molecules and cell organization, biological membranes, energy and metabolism, photosynthesis, cell division (mitosis and mycosis), DNA replication, protein synthesis, heredity, micro-organisms, tissues.
EENG354	Physiology for Biomedical Engineers	3	In this course the following subjects are treated: bone tissue, joints, muscular tissue, nervous tissue, spinal cord, brain, autonomic nervous system, cardiovascular system, digestive system, urinary system.
CENG352L	Digital Logic Circuits Lab	1	This lab introduces experiments concerning designing, simulating and testing digital logic circuits, which uses Combinational Logic Design; Decoders and Encoders, Multiplexers, signed number notations and arithmetic; binary addition/subtraction circuits; PLA, PAL, theory of sequential circuits; timing diagrams; analysis and synthesis of D, JK, and T flip flop based sequential circuit; Design with D and JK flip-flops. The objective of this course is to cover experimentally all experiments on Com3lab boards (70017 & 70018) that are related to the topics above. After that, each group of two students should have the tools to build combinatory circuits, where those circuits will be given as small projects where each group should write down the design and complete the implementation.
EENG350	Electronic Circuits I	3	Electrical signals and amplifier models. Semiconductors. P-N Junction: current-voltage characteristics. Diode models. Diode circuit applications. Metal Oxide Semiconductor Field-Effect Transistor (MOSFET): structure, current-voltage characteristics, DC biasing, small-signal model, MOSFET amplifiers. Bipolar junction transistor (BJT): structure, current-voltage characteristics, DC biasing, small-signal model, BJT amplifiers.
EENG350L	Electronic Circuits I Lab	1	The topics covered by this Lab course are amplifier characteristics, Diode Characteristics & Circuit Applications, Zener Diode Characteristics & Circuit Applications. Also, MOSFET and BJT Characteristics and Amplifiers will be covered. Spice simulation and breadboard implementation will be used.
EENG385	Signals and Systems	3	Signal and system modeling concepts; system modeling and analysis in time domain; the Fourier series; the Fourier transform and its applications; the Laplace transformation and its applications; analysis and design of analog filters, MATLAB for analog signal processing.
EENG388	Electromagnetic Fields and Waves	3	This is an introductory course in Electromagnetics covering Vector analysis, Electrostatics, Magnetostatics, Maxwell□s equations and Plane Wave Propagation.

EENG400	Electronic Circuits II	3	This course deals with BJTs and FETs frequency response analysis, examines operational amplifiers theory in order to discover its performance and applications, namely: Voltage summing, buffers, controlled sources, instrumentation circuits and active filters. The course also treats power amplifiers of different classes (Class: A, B, C and D). Finally, Voltage controlled oscillators, PLL and Digital to analogue converters will be also presented as well as the Analysis and design of different types of oscillators.
EENG400L	Electronic Circuits II Lab	1	The topics covered by this Lab course are MOSFET and BJT frequency response, feedback amplifier operation and characteristic, oscillators and multivibrators, power amplifier DC operation, voltage and power Gain. Spice simulation and breadboard implementation will be used.
EENG484	Acquisition & Microcontrollers in Biomedical Engineering	3	This course examines sensors employed for biological and biomedical applications. Focus will be concentrated on the components of data acquisition systems and particularly on the sensors which represent the first element of the data acquisition chain. A broad range of biosensors, whose role is to convert information from one form of energy to electrical signals, will be introduced. In this case the final form for the information will be an electrical signal but the transducers themselves could be optical, mechanical, etc., and operate in a number of different ways (eg., capacitive, potentiometric, photonic).
EENG424	Medical Instrumentation I	3	The course covers the following topics. Basic concepts of medical instrumentation, basic sensors and principles, amplifiers and signal processing, biopotential electrodes, biopotential amplifiers, blood pressure and sound, measurement of flow and volume of blood, measurements of the respiratory system, chemical biosensors, clinical laboratory instrumentation, therapeutic and devices, electrical Safety.
EENG424L	Medical Instrumentation I Lab	1	This laboratory course introduces the basic principles of medical instrumentation. The principle of operation and basic operation procedures are introduced. Basic medical instrumentation circuits are implemented and tested. Topics include: Blood pressure measurement, Heart rate monitors, Oximeters, Electromyography, Electroencephalography, Temperature monitoring, Ventilators, Doppler flow meters, and Laboratory safety.
EENG474	Medical Imaging I	3	This course introduces imaging methods in medicine and biology. Covered medical imaging systems include conventional X-ray, computed tomography (CT), magnetic resonance imaging (MRI), nuclear medicine (PET and SPECT), and ultrasound. Each of these modalities will be introduced from basic physical principles to the process of image formation. Basic concepts in medical image processing and analysis will also be introduced.
EENG574	Medical Instrumentation II	3	This course is a natural extension of the Medical Instrumentation I course offered in the third year of the BS program. It describes the physiological basis and engineering principles of various medical equipments. It also introduces the principles of operation and the performance parameters of a wide range of instruments including recording and monitoring instruments, measurement and analysis techniques, and therapeutic equipment.

EENG574L	Medical Instrumentation II Lab	1	This lab course builds on the topics covered in the EENG574 course where students are introduced to the theory, design, and main components of a variety of medical equipment (blood counters, electrosurgical units, pacemaker, defibrillators, oximeters, anesthesia machines, lithotripters, ventilators, and Hemodialysis delivery systems). This laboratory provides thorough understanding of the operation of these equipment and instructions on their calibration, and testing of their performance. In addition, students are expected to complete two term projects that provide them with hands-on experience in designing and building medical devices prototypes, and allow them to apply their knowledge of sensors, electric circuits, electric safety, and data display in a new context. Term projects ideas are to be suggested but not forced by the lab instructor. Examples of suggested term projects are: designing and implementing a photoplethysmogram, heart beat monitor, etc.
EENG504	Biomechanics	3	This course provides first an introduction of a constitutive equation, stress-strain relationships, shear rate, viscous and nonviscous fluids, elasticity, linear and nonlinear viscoelasticity, etc. Certain rheological models are derived. The rheometers used to determine the rheological properties of blood are described. The biofluid mechanics in the cardiovascular system are also treated, including the biomechanics of vessels and heart. Finally, the mechanical properties of muscles, ligaments, tendons and bones are studied.
EENG524	Medical Imaging II	3	This course covers image reconstruction for both X-ray computed tomography and for nuclear medicine applications. Magnetic resonance imaging and reconstruction and imaging techniques are presented in details. Introduction to infrared medical imaging techniques. Research topics in the medical imaging domain are treated and discussed in this course.
EENG534	Signal Processing for Medicine I	3	This course covers the basic concepts such as noise, ensemble averaging, spectral analysis: classical methods, digital filters, spectral analysis: modern techniques, time frequency methods, the wavelet transform, advanced signal processing techniques.
EENG534L	Signal Processing for Medicine I Lab	1	This laboratory course introduces the basic signal processing techniques, including an introduction to MATLAB, creation of function, digital signal processing techniques, and digital filters.
EENG634L	Image Processing for Medicine Lab	1	This laboratory provides students with practical knowledge of image formation, and image processing techniques like spatial-domain filters, Fourier-domain filters, image enhancement, registration and segmentation. In this laboratory, students are expected to gain experience in these image processing techniques by practicing image processing exercises using Matlab software Image Processing Toolbox, and ImageJ software developed by the US National Institute of Health. At the end of the semester, students are expected to apply their acquired knowledge on the processing of real imaging datasets, for example, filtering out breathing noise from an MRI dataset

EENG554	Biomaterials and Artificial Organs	3	The course is focused on biomaterials and artificial organs. Indeed, the replacement__augmentation of failing human organs with artificial devices and systems has been an important element in health care for several decades. Significant advances in the biomedical technologies have continuously occurred during the previous 50 years, saving numerous lives with cutting edge technologies. The basic physiology of each system is reviewed with emphasis on identifying the bioengineering design requirements for appropriate biomaterials and organ replacement systems. This course brings together fundamental engineering and life science principles to provide a focused coverage of various classes of biomaterials, prostheses and artificial organs. It emphasizes on the properties original organ to be substituted as well as on the evaluation of the substitute. Commercially available systems are analyzed from the point of view similarity to the host, biomechanics, and size and efficiency of the device. Student will be required to design an artificial organ consistent with the above mentioned considerations.
EENG564	Robotics and Telemedicine	3	This course introduces telemedicine technology, a very broad scope defined as the use of telecommunications to allow caregivers to interact with patients and/or other caregivers operating at remote locations. We first define and then discuss emerging efforts at utilizing telemedicine in ways that may be pertinent to medical and surgical practices. Economics of telemedicine practice are examined, followed by some futuristic thoughts about telemedicine in different medicine fields (Radiology, Emergency, Surgery.). The course emphasizes on current uses and application of telecommunications approaches for medical diagnosis and patient care. Thus it focuses on the status of the technology, where information and telecommunication technology has developed effective and efficient tools for delivering health services to widely dispersed populations, and has allowed for the provision of medical services to sites that are physically separated from the provider. The course examines the capabilities of this technology extension to the reach of medical facilities and resources, promoting efficiency, productivity, improved quality of care, better communication between providers, increased beneficiary access to specialists, reduced transportation expenses, and increased cost efficiency. The course deals with Telemedicines three areas: decision-making aids, remote sensing, and collaborative arrangements for real-time management of patients at a distance using a wireless mobile robotic technology.
EENG634	Image Processing for Medicine	3	This course aims to enable the students to develop their own imaging solutions using Matlab and Mathematica and the Biomedical Digital Image Processing application package and to give the attendees a detailed comprehensive demonstration of Matlab and Mathematicas relevant features and capabilities.
EENG674	Medical Laboratory Instrumentation	3	This course is designed to fill the gap in the scientific communication between biomedical engineers and physicians, to give students an understanding of how scientists with medical__scientific degrees treat tests and clinical cases in both hospital and academic settings. There will be interactive discussions with research clinicians and scientists about the challenges in the medical and biomedical field, and how a biomedical engineer can interact with the doctor to deliver the best solutions for the patient.
EENG674L	Medical Laboratory Instrumentation Lab	1	This laboratory course offers practical applications to medical laboratory instrumentation equipment. Laboratory sessions include description of the equipment and their principle of operation. Regular maintenance and quality control principles are introduced. Tests are performed on controlled samples and results are interpreted accordingly. Topics discussed include: Blood Collection and Centrifuge, Electrocardiography, Hematology, Microscopy, Spectrophotometry, Spirometry, Stethoscopes, and heart sounds.

EENG484L	Acquisition and Microcontrollers in Biomedical Engineering Laboratory	1	This laboratory course is designed to implement biomedical signal sensing and data acquisition techniques. Experiments are designed to explore the sampling theorem including filtering and aliasing. Experiments are also designed to deal with signal conditioning and circuit trouble-shooting. Data acquisition is implemented using PIC microcontrollers, Arduino, and myDAQ. Programming is performed using LabView, Matlab, Arduino C, and Assembly
EENG594	Capstone Project	6	This project is a requirement for graduation with the B.S. in Engineering degree. Proposed by the supervising faculty, projects are geared towards integrating several topics covered in the curriculum. Students will have the opportunity to exercise research, experimentation, implementation and technical writing skills. Students typically work in teams; each team agrees on a project with the supervisor. The project scope must be adjusted to match at least a 3 credit load per team member. The project concludes with a demonstration, a presentation and a technical report all of which are appraised by a committee of faculty members.
EENG404	Biophysics and Bioelectricity	3	This is an introductory course on biophysics for undergraduate students. The first part deals with properties of biologic materials. The second part treats the cellular and molecular biophysics and covers, in depth, the molecular phenomena related to biologic processes. Organ systems and the principles of physics in the processes of locomotion, blood and fluid flow, respiration, audition and vision are addressed in the third part. The fourth part deals with bioelectric phenomena such as resting and action potentials with their physical tools. Radioactivity and biologic effect of ionizing radiation will be treated in the fifth part.
CENG250	Digital Logic I	3	This course introduces the concepts of digital logic operations and design. The course teaches fundamentals of digital logic design through the use of a large number of design problems. Topics include: Boolean algebra, theory of logic functions; mapping techniques and function minimization; logic equivalent circuits and gate transformations; base conversion number notations and arithmetic; binary addition/subtraction, decoder, encoder, comparator, multiplexer and de-multiplexer circuits in combinational systems. It also teaches introductory sequential systems specifically, latches, flip-flops and the design of basic synchronous counters.
EENG354L	Physiology for Biomedical Engineers Lab	1	This lab deals with the structure of the human body. It includes the study of tissues, skeletal, muscular, nervous, cardiovascular (Heart), digestive and urinary systems. It is presented using microscopic slides, human skeletal models, anatomical models, drawings, and dissections.
EENG435	Control Systems	3	Introduction to Control Systems. Open and Closed-loop feedback systems. Modelling of dynamic. Block diagrams and signal flow graphs. Transient and steady state response analysis. Root-Locus analysis, stability of control systems. Control system design (Lead, Lag, and Lead-Lag compensation), Frequency response analysis techniques. PID, PD and P correctors.
EENG435L	Control Systems Lab	1	The Control Systems Lab is concerned with the following topics: introducing MATLAB and its Control Systems Toolbox; plotting the pole-zero configuration in s-plane for a given transfer function; determining the transfer function for a given closed loop system in block diagram representation; plotting the unit-step response of given transfer function and finding the maximum overshoot, peak time, rise time and delay time; calibrating a PID Controller; plotting the root locus of a given transfer function and locating closed loop poles for different values of gain; plotting the bode plot of a given transfer function and finding the gain and phase margins; plotting the Nyquist plot for a given transfer function and discussing closed loop stability, gain and phase margins.

EENG414	Biocompatibility	3	This course covers the following topics. Biocompatibility standards including the role of material standardization and validation methods in evaluating biocompatibility, biodegradation and toxic kinetic, surface analysis of polymeric biomaterials, sterilization processes and residuals, cytotoxicity, interactions with blood, genotoxicity, carcinogenicity and reproductive toxicity, explants retrieval and analysis, assessment of biological safety, risk analysis.
EENG464L	Biomedical Engineering Field Visit	1	Students will conduct a field visit to a hospital to acquire knowledge in a practical and real world manner and supplement the lessons learned in the classroom. A report will need to be produced based on student observations. The course is concluded by a student presentation.